

Evidence Based Design:

Connecting Strategies and Objectives through Research

FY10 Checklist Final Report
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Executive Summary

Scope: The following pages are an analysis of the evidence associated with each of the Evidence Based Design strategies from the 2010 checklist (May 20 GT Version). Only strategies that have 'EBD' listed in the 'Source' field from the database are analyzed in this report. The reference list evaluated included citations from the following sources:

- The EBD Checklist 2010 (included only relevant references from 09-10 Checklist)
- Ulrich, Zimring, et. al. (2008). A Review of the Research Literature on Evidence-Based Healthcare Design. HERD, 1(3): 61-125.
- Joseph, Anjali. Center for Health Design Issue papers #1-4

Some new sources were located; however, finding new references was not the purpose of this evaluation.

Process: Two initial meetings were held to determine the scope, standardize the reporting form, divide the strategies among the six team members, and collaborate on initial thoughts and ideas. From June 7 through June 29 the research team evaluated over 200 articles for 88 EBD strategy objective links.

Articles were evaluated on the basis of fitting into one or more of the following categories:

- Empirical: uses data about the strategy and associated outcomes and provides a detailed description of the methodology used
- Expert Opinion: no empirical data only opinions listed
- Background discussion: discusses case studies, best practices, issues, mechanisms, history, etc.

If the reference did not fit into one of these categories and/or did not specifically address the linkage between the strategy and the objective, it was not included in the final reference list. Therefore, more than the 195 articles listed were evaluated and subsequently thrown out of the study.

Each relevant reference article is summarized and the setting, study design, and if it was in a peer-reviewed journal was noted.

After all articles were evaluated for a particular strategy-objective link, the researcher summarized the available evidence and commented on any benchmarks identified and proposed changes to the strategy objective linkage.

Conclusions: There were 38 strategy-objective linkages (43%) that had less than two (either zero or one) cited references that supported the linkage between the strategy and the objective. This means that the strategy may have been documented in one of the sources listed above, but there is no evidence to link the strategy to the objective.

Next Steps: There are many future opportunities to further connect the Checklist strategies to objectives through research.

1. The evidence strength needs to be given an objective score that can be incorporated in the checklist as a reference point for users.
2. All strategy-objective links (not just 'EBD' linkages) need to be formally evaluated.
3. A formal literature review should be conducted to find new (post 2008) references.
4. New research needs to be conducted that evaluates the strategy-objective links with little evidence strength.

Strategy 2: Same-handed patient rooms

Objective 25: Eliminate/prevent patient harm

Principle 2: Achieve world-class quality and safety

Proposed Changes: Same-handed rooms may improve patient safety due to the impact of standardization on work performance. However, no research has been conducted to test this proposition.

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 0

Total References: 1

Research Summary: In the absence of research on safety and same-handed rooms, a healthcare consultant at HDR was contacted by phone (Cyndi McCollough, 6/21/2010). She noted that clients easily go for same-handed rooms for exam rooms, ED, and surgery, where they are no more expensive than mirrored rooms. However, they are probably more expensive in patient rooms, due to the need to duplicate plumbing. However, she feels they are still worthwhile because the patient room is where most errors are made, and clinicians from client buildings are reportedly more satisfied with same-handed room layouts. However, there is no research on same-handed rooms. We cannot make an evidence-based recommendation that same-handed rooms increase patient safety.

Metric Status: No metrics found

Metric Discussion: Y/N, and for which rooms

Researcher Initials: JZ

Reference Citations:

McCollough, C. (2009). Evidence-based design for healthcare facilities. Sigma Theta Tau International: Indianapolis, IN.

Strategy 5: Install ceiling or wall-mounted lifts in all inpatient rooms

Objective 32: Eliminate staff injuries

Principle 3: Create a positive work environment

Proposed Changes: None

Empirical Articles: 8

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 8

Total References: 10

Research Summary: Strong evidence exists for the benefits of ceiling lifts.

Patient lifting in particular is a major cause of injury to healthcare workers. According to Fragala and Bailey (2003), 44 percent of injuries to nursing staff in hospitals that result in lost workdays are strains and sprains (mostly of the back). Reducing injuries that result from patient-lifting tasks cannot only result in significant economic benefit (reduced cost of claims, staff lost workdays), but also reduce pain and suffering among workers.

Metric Status: Benchmark in place

Metric Discussion: The research points toward the provision of ceiling lifts as the appropriate metric.

Staff preferred overhead ceiling lifts to other methods of transfer (manual or floor lifts) when lifting or transferring residents (Engst, C., et al., 2005). Another study evaluated the effectiveness of replacing floor lifts with mechanical ceiling lifts in the extended care unit of a British Columbia hospital (Ronald, L. A., et al., 2002). It showed the rate of staff injuries caused by lifting/transferring patients was significantly reduced (58% reduction, $p = .011$) after replacing floor lifts with ceiling lifts.

Researcher Initials: YL

Reference Citations:

Evanoff, B., Wolf, L., Aton, E., Canos, J., & Collins, J. (2003). Reduction in injury rates in nursing personnel through introduction of mechanical lifts in the workplace. American Journal of Industrial Medicine, 44(5), 451-457.

Fragala, G. and Bailey, L. (2003). Addressing Occupations Strains and Sprains: Musculoskeletal Injuries in Hospitals. AAOHN Journal 51 (6): 252-259.

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Joseph, A., & Fritz, L. (2006). Ceiling lifts reduce patient-handling injuries. Healthcare Design, 6(1), 10-13.

Keir, P., & MacDonell, C. (2003). Muscle activity during patient transfers: a preliminary study on the influence of lift assists and experience. [Article]. Ergonomics, 47(3), 296-306.

Li, J., Wolf, L., & Evanoff, B. (2004). Use of mechanical patient lifts decreased musculoskeletal symptoms and injuries among health care workers. [Article]. Injury Prevention, 10(4), 212-216.

Miller, A., Engst, C., Tate, R. B., & Yassi, A. (2006). Evaluation of the effectiveness of portable ceiling lifts in a new long-term care facility. Applied Ergonomics, 37(3), 377-385.

Nelson, A. and Baptiste, A. (2004). Evidence-based Practices for Safe Patient Handling and Movement. Online Journal of Issues in Nursing. 9 (3).

Ronald, L. A., Yassi, A., Spiegel, J., Tate, R. B., Tait, D., & Mozel, M. R. (2002). Effectiveness of installing overhead ceiling lifts: reducing musculoskeletal injuries in an extended care hospital unit. American Association of Occupational Health Nurse

Yassi, A., Cooper, J. E., Tate, R. B., Gerlach, S., Muir, M., Trottier, J., et al. (2001). A randomized controlled trial to prevent patient lift and transfer injuries of health care workers. Spine, 26(16), 1739-1746.

Strategy 6: Institute an integrated facility-wide Lift Program

Objective 32: Eliminate staff injuries

Principle 3: Create a positive work environment

Proposed Changes: None

Empirical Articles: 3

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 3

Total References: 3

Research Summary: A no-manual lift policy, combined with use of mechanical lifts, has been successful in reducing back injuries that result from patient-handling tasks (Engstand et al. 2005; Garg and Owen 1992; Gargand et al. 1991; Joseph and Fritz 2006; Millerand et al. 2006). For example, when PeaceHealth in Oregon installed ceiling lifts in most patient rooms in their intensive-care unit and neurology unit, they found that the number of staff injuries related to patient handling came down from ten in the two years preceding lift installation to two in the three years after lift installation (Joseph and Fritz 2006). The annual cost of patient-handling injuries in these units was reduced by 83 percent after the lifts were installed (Joseph and Fritz 2006). This study, as well as others (Engst 2005, Evanff 2003), has emphasized the importance of instituting a no-manual lift policy (along with the installation of mechanical lifts) in hospitals to prevent such injuries from occurring.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YL

Reference Citations:

Chhokar, R., Engst, C., Miller, A., Robinson, D., Tate, R. B., & Yassi, A. (2005). The three-year economic benefits of a ceiling lift intervention aimed to reduce healthcare worker injuries. *Applied Ergonomics*, 36(2), 223-229.

Engst, C., Chhokar, R., Miller, A., Tate, R. B., & Yassi, A. (2005). Effectiveness of overhead lifting devices in reducing the risk of injury to care staff in extended care facilities. *Ergonomics*, 48(2), 187-199.

Smedley, J., Trevelyan, F., Inskip, H., Buckle, P., Cooper, C., & Coggon, D. (2003). Impact of ergonomic intervention on back pain among nurses. *Scandinavian Journal of Work and Health*, 29(2), 117-123.

Strategy 16: Provide a visual and sound barrier between care space and family space in the patient room

Objective 3: Provide appropriate levels of patient privacy

Principle 1: Provide patient and family-centered care

Proposed Changes: no evidence/questionable

Empirical Articles:

Expert Opinion Articles:

Background Discussion articles:

Peer reviewed articles:

Total References:

Research Summary: No evidence found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YS

Reference Citations: None

Strategy 18: Provide acuity-convertible rooms

Objective 25: Eliminate/prevent patient harm

Principle 2: Achieve world-class quality and safety

Proposed Changes: ICU convertible implies room that is mechanically able to adjust, as distinct from a room that is built with the intention of providing care from admission to discharge. Strike “ICU-convertible rooms” and replace with “acuity-adaptable rooms.”

Empirical Articles: 1

Expert Opinion Articles:

Background Discussion articles: 3

Peer reviewed articles: 4

Total References: 4

Research Summary: Acuity-adaptable rooms are thought to decrease patient risk secondary to handoffs and communication gaps. They may increase productivity.

Metric Status: Benchmark in place

Metric Discussion: Acuity adaptable implies both a design and care model. Building the space alone does not ensure that patients remain in that space from admission to discharge. Metrics should ascertain commitment to the acuity-adaptable care model.

Researcher Initials: MO

Reference Citations:

Brown, K. K., & Gallant, D. (2006). Impacting patient outcomes through design: acuity adaptable care/universal room design. Critical Care Nursing Quarterly, 29(4), 326-341.

Hendrich, A. L., Fay, J., & Sorrells, A. K. (2004). Effects of acuity-adaptable rooms on flow of patients and delivery of care. [Article]. American Journal of Critical Care, 13(1), 35-45.

Institute of Medicine. (2004). Work and workspace design to prevent and mitigate errors. In A. Page (Ed.). Keeping patients safe: Transforming the work environment of nurses (pp. 226-285). Washington, DC: National Academies Press.

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Strategy 20: Provide acuity adaptable rooms

Objective 16: Minimize patient movement

Principle 2: Achieve world-class quality and safety

Proposed Changes: Change or add to OBJ 6: Eliminate medication errors and/or OBJ 61: Optimize workplace efficiency and/or OBJ 18: Maximize patient care coordination

Empirical Articles: 1

Expert Opinion Articles: 3

Background Discussion articles: 1

Peer reviewed articles: 3

Total References: 5

Research Summary: Common sense that reducing transfers reduces harm; research shows decrease in medical errors and transfers but no causal relationship between the two; IOM report states reducing transfers saves staff time, shortens patient stays, and reduces cost

Metric Status: 3

Metric Discussion: Report goal for number of transfers and an operational plan for reaching the targeted goal

Researcher Initials: AW

Reference Citations:

Cook, R. L., Render, M., & Woods, D. D. (2000). Gaps in the continuity of care and progress on patient safety. British Medical Journal, 320(7237), 791-794.

Hendrich, A. L., Fay, J., & Sorrells, A. K. (2004). Effects of acuity-adaptable rooms on flow of patients and delivery of care. American Journal of Critical Care, 13(1), 35-45.

Hendrich, A., Fay, J., & Sorrells, A. (2002). Courage to heal: Comprehensive cardiac critical care. Healthcare Design, 11-13.

Institute of Medicine. (2004). Keeping patients safe: Transforming the work environment of nurses. Washington, DC: National Academies Press.

Ulrich, R., & Zhu, X. (2007). Medical complications of intra-hospital patient transports: Implications for architectural design and research. Health Environments Research and Design Journal 1(1), 31-43.

Strategy 20: Provide acuity adaptable rooms

Objective 25: Eliminate/prevent patient harm

Principle 2: Achieve world-class quality and safety

Proposed Changes: This strategy should be more fine-grained. It currently suggests the question "Is your entire hospital acuity-adaptable?", when it is more realistic to recommend acuity adaptability for ICU, CCU, and additional units based on the exigencies of the client. A fully-acuity adaptable scheme (i.e., all rooms acuity adaptable) is not practical for very large hospitals and may be impractical even in smaller hospitals for reasons of workplace culture. However, certain principles of acuity adaptability could be applied to a narrower set of spaces in almost any hospital. For example, most hospitals could implement a Surgical Intensive Care Unit or acuity-adaptable cardiac care unit.

Empirical Articles: 2

Expert Opinion Articles: 1

Background Discussion articles: 2

Peer reviewed articles: 3

Total References: 4

Research Summary: The switch from multiple CCUs to a single acuity-adaptable CCU was associated with reduced clinician handoffs, transfers, medication errors, and patient falls, as well as with increases in patient satisfaction and nurse time spend in direct care without overall increased nurse work time (Hendric et al., 2004). Precedents identified in the literature have acuity-adaptable rooms for particular service lines, often cardiac.

Metric Status: 0

Metric Discussion: Y/N or percent inpatient rooms/percent nursing units that are acuity-adaptable. If the checklist is to guide design, certain specifics should be provided (room size, MEP requirements), probably from AIA or JCAHO standards.

Researcher Initials: JZ

Reference Citations:

Brown, K. K., & Gallant, D. (2006). Impacting patient outcomes through design: acuity adaptable care/universal room design. Critical Care Nursing Quarterly, 29(4), 326-341.

Hendrich, A. L., Fay, J., & Sorrells, A. K. (2004). Effects of acuity-adaptable rooms on flow of patients and delivery of care. [Article]. American Journal of Critical Care, 13(1), 35-45.

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Porter J. M., Ivatury R. R., Kavarana M., & Verrier R. The surgical intensive care unit as a cost-efficient substitute for an operating room at a Level I trauma center. American Surgeon, 1999 65 (4), 328-330.

Strategy 22: Maximize glazable dimension on outside inpatient room wall

Objective 12: Provide a healing built environment

Principle 1: Optimize exposure to natural light.

Proposed Changes: Specify lux and supplemental lighting depending upon room orientation.

Empirical Articles: 7

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 7

Total References: 8

Research Summary: Light was shown to decrease stress and increase satisfaction, with the potential to decrease mortality and LOS with lux 500-5000.

Metric Status: Various metrics found (no consensus)

Metric Discussion: There is a high degree of variance in the suggested metric- 500-5000 lux for improved outcomes. We could conservatively suggest a minimum of 500 lux. (200 lux was observed in north-facing rooms)

Researcher Initials: MO

Reference Citations:

Alimoglu, M. K., & Donmez, L. (2005). Daylight exposure and the other predictors of burnout among nurses in a University Hospital. International Journal of Nursing Studies, 42(5), 549-555.

Beauchemin, K. M., and Hays, P. (1996). Sunny hospital rooms expedite recovery from severe and refractory depressions. Journal of Affective Disorders, 40(1-2), 49-51.

Beauchemin, K., & Hays, P. (1998). Dying in the dark: sunshine, gender and outcomes in myocardial infarction. Journal of the Royal Society of Medicine, 91(7), 352-354.

Harris, P. B., McBride, G., Ross, C., & Curtis, L. (2002). A place to heal: Environmental sources of satisfaction among hospital patients. Journal of Applied Social Psychology, 32(6), 1276-1299.

Joseph, A. (2006). Impacts of Light on Outcomes in Healthcare Settings. The Center for Health Design. Issue Paper #2.

Martiny, K. (2004). Adjunctive bright light in non-seasonal major depression. Acta Psychiatrica Scandinavia, 110 (Suppl. 425), 7-28.

T L Van Natta, J A Morris, Jr, V A Eddy, C R Nunn, E J Rutherford, D Neuzil, J M Jenkins, and J G Bass. (1998). Elective bedside surgery in critically injured patients is safe and cost-effective. Ann Surg. May; 227(5): 618-626.

Walch, J. M., Rabin, B. S., Day, R., Williams, J. N., Choi, K., & Kang, J. D. (2005). The effect of sunlight on post-operative analgesic medication usage: A prospective study of spinal surgery patients. Psychosomatic Medicine, 67(1), 156-163.

Strategy 24: Provide natural light in as many occupied spaces as possible

Objective 4: Maximize patient/family satisfaction

Principle 1: Provide patient and family-centered care

Proposed Changes: We should be more specific about where windows are likely to benefit patient/family satisfaction. "As many as possible" is vague standard, and in being vague it is easily side-stepped.

Empirical Articles: 1

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 1

Research Summary: The presence of bright, not "gloomy" lighting) was associated with satisfaction among discharged inpatients.

Metric Status: No metrics found

Metric Discussion: We should locate research or expert opinions on where patient/family satisfaction will be most improved by windows.

Researcher Initials: JZ

Reference Citations:

Harris, P. B., McBride, G., Ross, C., & Curtis, L. (2002). A place to heal: Environmental sources of satisfaction among hospital patients. Journal of Applied Social Psychology, 32(6), 1276-1299.

Strategy 24: Provide natural light in as many occupied spaces as possible

Objective 12: Provide a healing built environment

Principle 1: Provide patient and family-centered care

Principle 3: Create a positive work environment

Principle 5: Be sustainable with a high level of community

Proposed Changes: If windows are to promote healing, then the appropriate focus of this strategy is on the patient room. Therefore I suggest we change the strategy to "Provide bright, natural light in patient rooms". This has implications for window design and building massing decisions. Windows are already mandated in patient rooms, so it seems sensible to make a recommendation for "bright, natural" light above and beyond the already-required window. The references cited support the healing effects of bright light, which need to be balanced against avoiding glare and nighttime light pollution.

Empirical Articles: 5

Expert Opinion Articles: 0

Background Discussion articles: 2

Peer reviewed articles: 6

Total References: 8

Research Summary: Brighter light in patient rooms has been found to result in positive patient outcomes for surgery recovery, affective disorder, and recovery from heart attack (more strongly impacting females). Daylight is also necessary to maintenance of circadian rhythms.

Metric Status: Various metrics found (no consensus)

Metric Discussion: Per Beauchemin, daytime lux of 200-400 is low and 2000 is high. Per Walsh, high is 73,537 lux-hours and low is 50,410 lux-hours.

Researcher Initials: JZ

Reference Citations:

Altimier, L. B., Eichel, M., Warner, B., Tedeschi, L., & Brown, B. (2005). Developmental care: changing the NICU physically and behaviorally to promote patient outcomes and contain costs. Neonatal Intensive Care, 18(4), 12-16.

BaHammam, A. (2006). Sleep in acute care units. [Review]. Sleep and Breathing, 10(1), 6-15. (Light/dark exposure important to maintaining circadian rhythms; a review)

Beauchemin, K. M., and Hays, P. (1996). Sunny hospital rooms expedite recovery from severe and refractory depressions. Journal of Affective Disorders, 40(1-2), 49-51.

Beauchemin, K., & Hays, P. (1998). Dying in the dark: sunshine, gender and outcomes in myocardial infarction. Journal of the Royal Society of Medicine, 91(7), 352-354. (Shorter LOS in rooms with 2000 lux vs 200-400 lux)

Benedetti, F., Colombo, C., Barbini, B., Campori, E., and Smeraldi, E. (2001). Morning sunlight reduces length of hospitalization in bipolar depression. Journal of Affective Disorders, 62(3), 221-223.

Joseph, A. (2006). Impacts of Light on Outcomes in Healthcare Settings. The Center for Health Design. Issue Paper #2.

Nelson, C. West, T., Goodman, C. (2005). The Hospital Built Environment: What Role Might Funders of Health Services Research Play? Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

Walch, J. M., Rabin, B. S., Day, R., Williams, J. N., Choi, K., & Kang, J. D. (2005). The effect of sunlight on post-operative analgesic medication usage: A prospective study of spinal surgery patients. Psychosomatic Medicine, 67(1), 156-163.

Strategy 24: Provide natural light in as many occupied spaces as possible

Objective 33: Optimize staff satisfaction / optimize staff performance

Principle 3: Create a positive work environment

Principle 4: Improve operational effectiveness

Proposed Changes: Can we be more specific about where windows are likely to benefit staff? Further, it is suggested to make a separate point about optimizing staff satisfaction (which appears to be associated with natural light) and optimizing performance (which appears to be associated with brightness of light, regardless of source).

Empirical Articles: 1

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 1

Total References: 2

Research Summary: The Alimglou study gives some correlation to support to an indirect relationship between daylight exposure for nurses at work and work-related stress and job satisfaction. The Joseph review does not provide direct support for daylight as beneficial to hospital workers in particular, though there is evidence that higher lighting levels (irrespective of source) contribute to decreased task errors and that office workers are generally more satisfied with daylight. There is also a fairly general discussion of positive aspects of daylight.

Metric Status: No metrics found.

Metric Discussion: 3 hours of daylight exposure was used in the Alimglou study

Researcher Initials: JZ

Reference Citations:

Alimoglu, M. K., & Donmez, L. (2005). Daylight exposure and the other predictors of burnout among nurses in a University Hospital. International Journal of Nursing Studies, 42(5), 549-555.

Joseph, A. (2006). Impacts of Light on Outcomes in Healthcare Settings. The Center for Health Design. Issue Paper #2.

Strategy 33: Provide larger patient zone to support in-room procedures

Objective 25: Eliminate/prevent patient harm

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 3

Background Discussion articles: 1

Peer reviewed articles: 1

Total References: 3

Research Summary: Research suggests that decreased patient movement impacts outcomes. This may logically extend to movement for procedures would be much different.

Metric Status: No metrics found

Metric Discussion: It is reasonable to conclude that decreasing transfers by performing procedures at the bedside is a good idea. However there is no agreement as to how big a room is big enough. At this point, the best recommendation may be to analyze room size with mockups and on-site testing.

Researcher Initials: MO

Reference Citations:

Hendrich, A. L., Fay, J., & Sorrells, A. K. (2004). Effects of acuity-adaptable rooms on flow of patients and delivery of care. [Article]. American Journal of Critical Care, 13(1), 35-45.

Reiling, J; Hughes,G; Murphy,M. (2004). The Impact of Facility Design on Patient Safety. In Patient Safety and Quality: An evidence-based handbook for nurses, Chapter 28. Agency for Healthcare Quality and Research, Rockville, MD. pp.167-192.

Samuels, Owen. (2009). Redesigning the neurocritical care unit to enhance family participation and improve outcomes. Cleveland Clinic Journal of Medicine, 76(2): 70-74.

Strategy 42: Provide adequate lighting levels in staff work areas

Objective 21: Eliminate medication errors

Principle 2: Achieve world-class quality and safety

Proposed Changes: “Provide adequate lighting levels in pharmacy” may be a more appropriate strategy, as we only have evidence linking light levels to medication dispensing errors in pharmacy

Empirical Articles: 1

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 2

Total References: 3

Research Summary:

From Ulrich et al. (2008)

Poor lighting levels can also affect the performance of healthcare workers and lead to medical errors. One study has shown significantly lower rates of medication-dispensing errors when the lighting level for work-surfaces is sufficiently high (Buchanan, Barker, Gibson, Jiang, & Pearson, 1991).

From Joseph, A. (2006). The Center for Health Design. Issue Paper #3.

A few studies have shown that lighting levels and workplace design can impact errors in dispensing medication in pharmacies. One study examined the effect of different illumination levels on pharmacists' prescription-dispensing error rate (Buchanan et al. 1991). It found that error rates were reduced when work-surface light levels were relatively high (Buchanan et al. 1991). In this study, three different illumination levels were evaluated (450 lux; 1,100 lux; 1,500 lux). Medication dispensing error rates were significantly lower (2.6 percent) at an illumination level of 1,500 lux (highest level), compared to an error rate of 3.8 percent at 450 lux. This is consistent with findings from other settings that show that task performance improves with increased light levels (Boyce, Hunter, and Howlett 2003). □ lighting and task performance

Metric Status: Various metrics found (no consensus)

Metric Discussion:

Researcher Initials: YS

Reference Citations:

Buchanan, T. L., Barker, K. N., Gibson, J. T., Jiang, B. C., & Pearson, R. E. (1991). Illumination and errors in dispensing. *American Journal of Hospital Pharmacy*, 48(10), 2137-2145.

Joseph, A. (2006). Impacts of Light on Outcomes in Healthcare Settings. The Center for Health Design. Issue Paper #2.

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H., Choi, Y., et al. (2008). A review of the research literature on evidence-based healthcare design. *Health Environments Research & Design Journal*, 1(3), 61-125.

Strategy 42: Provide adequate lighting levels in staff work areas

Objective 33: Optimize staff satisfaction / optimize staff performance

Principle 3: Create a positive work environment

Proposed Changes: We should define what is meant by "adequate". Two strategies should be developed, one for performance, the other for satisfaction. Performance may focus on high light levels for vision-critical tasks. Satisfaction could focus on access to daylight, and lighting schemes that promote appropriate sleep patterns for shift workers.

Empirical Articles: 3

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 3

Total References: 4

Research Summary: Horowitz describes exposure to session of bright light during overnight work assisted shift workers in circadian adaptation. Buchanan describes high lighting levels in a pharmacy as associated with reduced medicine dispensing errors. The Alimglou study gives some correlation to support to an indirect relationship between daylight exposure for nurses at work and work-related stress and job satisfaction. The Joseph review does not provide direct support for daylight as beneficial to hospital workers in particular, though there is evidence that higher lighting levels (irrespective of source) contribute to decreased task errors and that office workers are generally more satisfied with daylight. There is also a fairly general discussion of positive aspects of daylight.

Metric Status: Various metrics found (no consensus)

Metric Discussion: Bright light associated with reduced medication dispensing errors: 146 foot-candles (better than 102 fc, which was better than 45 fc).

For assisting shift workers in maintaining circadian rhythms, episodes of 2500 lux exposure during night shift work was recommended. However, it was only helpful when shift workers also consistently slept at the same time each day, regarding of work schedule

Researcher Initials: JZ

Reference Citations:

Alimoglu, M. K., & Donmez, L. (2005). Daylight exposure and the other predictors of burnout among nurses in a University Hospital. International Journal of Nursing Studies, 42(5), 549-555.

Buchanan, T. L., Barker, K. N., Gibson, J. T., Jiang, B. C., & Pearson, R. E. (1991). Illumination and errors in dispensing. American Journal of Hospital Pharmacy, 48(10), 2137-2145.

Horowitz, T., Cade, B., Wolfe, J., & Czeisler, C. (2001). Efficacy of bright light and sleep/darkness scheduling in alleviating circadian maladaptation to night work. American Journal of Physiology - Endocrinology and Metabolism, 281, 384-391.

Joseph, A. (2006). Impacts of Light on Outcomes in Healthcare Settings. The Center for Health Design. Issue Paper #2.

Strategy 46: Install low-mercury florescent lamps

Objective 39: Reduce environment impact of materials

Principle 5: Be sustainable with a high level of community responsibility

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 1

Peer reviewed articles: 0

Total References: 1

Research Summary: Mercury is a persistent bioaccumulative and toxic chemical. Very small releases can lead to dangerous exposure, as this neurotoxin builds up in the food chain.

Metric Status: 0

Metric Discussion: Y/N metric may be appropriate. It should be referenced to industry information.

Researcher Initials: JZ

Reference Citations:

Green Guide for HealthCare, www.gghc.org

Strategy 48: Regularly maintained and operated ventilation systems

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 4

Expert Opinion Articles: 4

Background Discussion articles: 0

Peer reviewed articles: 5

Total References: 8

Research Summary: All research cited supports the association between regularly-maintained ventilation systems and decreased HAI.

Metric Status: Various metrics found (no consensus)

Metric Discussion: Ventilation systems on continuous cycle; regular cleaning of ventilation grilles; provide cleaning and maintenance plan

Researcher Initials: AW

Reference Citations:

AIA & FGI (American Institute of Architects and Facilities Guidelines Institute) (2006). Guidelines for design and construction of health care facilities. Washington, DC: American Institute of Architects.

ASHRAE. 2004. ASHRAE 62.1-2004 – Ventilation for Acceptable Indoor Air Quality (ANSI Approved). Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

Kumari, D. N. P., Haji, T. C., Keer, V., Hawkey, P. M., Duncanson, V., & Flower, E. (1998). Ventilation grilles as a potential source of methicillin-resistant *Staphylococcus aureus* causing an outbreak in an orthopedic ward at a district general hospital. [Article]. *Journal of Hospital Infection*, 39(2), 127-133.

Li, Y., Leung, G., Tang, J., Yang, X., Chao, C., Lin, J., et al. (2007). Role of ventilation in airborne transmission of infectious agents in the built environment—A multidisciplinary systematic review. *Indoor Air*, 17(1), 2–18.

Lutz, B. D., Jin, J. K., Rinaldi, M. G., Wickes, B. L., & Huycke, M. M. (2003). Outbreak of invasive *Aspergillus* infection in surgical patients, associated with a contaminated air-handling system. [Article]. *Clinical Infectious Diseases*, 37(6), 786-793.

Menzies, D., Fanning, A., Yuan, L., & FitzGerald, M. (2000). Hospital Ventilation and Risk for Tuberculosis Infection in Canadian Health Care Workers. *Annals of Internal Medicine*, 133(10), 779-789.

Schulster, L., & Chinn, R. Y. (2003). Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *Morbidity and Mortality Weekly Report Recommendation Report*, 52(RR-10), 1–42.

Uduman, S. A., Farrukh, A. S., Nath, K. N., Zuhair, M. Y., Ifrah, A., Khawla, A. D., et al. (2002). An outbreak of *Serratia marcescens* infection in a special-care baby unit of a community hospital in United Arab Emirates: The importance of the air conditioner duct as a nosocomial reservoir. Journal of Hospital Infection, 52(3), 175–180.

Strategy 50: Use of UVGI on drip pans and cooling coils in ventilation systems

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 4

Expert Opinion Articles: 2

Background Discussion articles: 1

Peer reviewed articles: 6

Total References: 7

Research Summary: All references support adoption except one, a history of UVGI research.

Metric Status: Various metrics found (no consensus)

Metric Discussion: Y/N metric; note which areas implemented

Researcher Initials: AW

Reference Citations:

Centers for Disease Control and Prevention (US). Environmental control for tuberculosis: basic upper-room ultraviolet germicidal irradiation guidelines for healthcare settings. Atlanta: CDC, National Institute for Occupational Safety and Health (US); 2009. DHHS (NIOSH) Publication No. 2009-105.

Griffiths, W. D., Bennett, A., Speight, S., & Parks, S. (2005). Determining the performance of a commercial air purification system for reducing airborne contamination using model micro-organisms: a new test methodology. *Journal of Hospital Infection*, 61 (3), pp. 242-247.

Ko, G., Burge, H., Nardell, E., & Thompson, K. (2001). Estimation of tuberculosis risk and incidence under upper room ultraviolet germicidal irradiation in a waiting room in a hypothetical scenario. *Risk Analysis: An Official Publication of the Society for Risk Analysis*, 21(4), 657-673.

Mendell, M., Fisk, W., Kreiss, K., Levin, H., Alexander, D., Cain, W., et al. (2002). Improving the health of workers in indoor environments: priority research needs for a national occupational research agenda. *American Journal of Public Health*, 92(9), 1430-1440.

Menzies, D., Popa, J., Hanley, J., Rand, T., & Milton, D. (2003). Effect of ultraviolet germicidal lights installed in office ventilation systems on workers' health and wellbeing: double-blind multiple crossover trial. *Lancet*, 362(9398), 1785-1791.

Nardell, E., Bucher, S., Brickner, P., Wang, C., Vincent, R., Becan-McBride, K., et al. (2008). Safety of upper-room ultraviolet germicidal air disinfection for room occupants: results from the Tuberculosis Ultraviolet Shelter Study. *Public Health Reports (Washington, D.C.: 1974)*, 123(1), 52-60.

Reed, N. (2010). The history of ultraviolet germicidal irradiation for air disinfection. *Public Health Reports (Washington, D.C.: 1974)*, 125(1), 15-27

Strategy 55: Provide patient bedside access to internet, education systems, television, blinds, lighting, and temperature

Objective 30: Maximize opportunities for patient/family participation in delivery of care and involvement in all care decisions

Principle 1: Provide patient and family-centered care

Proposed Changes: Research affirms need to optimize access to information, but does not specify how. Built environment, care process, and technology all play a role.

Empirical Articles: 3

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 3

Total References: 3

Research Summary: Information is the most important factor to families, although how access to information is accomplished has many factors.

Metric Status: 0

Metric Discussion: Could suggest single patient rooms, sleeping arrangements, care process, or technology to accomplish this goal.

Researcher Initials: MO

Reference Citations:

Åstedt-Kurki, P., Paavilainen, E., Tammentie, T. and Paunonen-Ilmonen, M. (2001). Interaction between adult patients' family members and nursing staff on a hospital ward. *Scandinavian Journal of Caring Sciences*, 15: 142-150. doi: 10.1046/j.1471-6712.2001.00012.x

Bijttebier P., Vanoost S., Delva D., Ferdinande P. & Frans E. (2001) Needs of relatives of critical care patients: perceptions of relatives, physicians and nurses. *Intensive Care Medicine* 27, 160-165.

Press Ganey, Inc. (2007). Hospital pulse report: Patient perspectives on American health care.

Strategy 56: Provide interoperability among all technology platforms

Objective 51: Anticipate and accommodate future and current technologies

Principle 4: Improve operational effectiveness

Proposed Changes: This strategy serves as a reminder. If it is to be more forceful (e.g., describing how or why to provide interoperability), it will need to be revised.

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 2

Peer reviewed articles: 0

Total References: 2

Research Summary: Both articles describe the importance of technology, among other things, in hospital design. Neither offers rules-of-thumb or guidelines for interoperability or technology integration

Metric Status: 0

Metric Discussion: None

Researcher Initials: JZ

Reference Citations:

Joseph, A., Keller, A., and Gulwadi, G. (2009). Improving the Patient Experience: Best Practices for Safety-Net Clinic Redesign. The Center for Health Design report for California Healthcare Foundation.

Steelcase 2006. "Case Study: Mayo Clinic." SPARC

Strategy 60: Decentralize staff support spaces (i.e., charting, supplies, medications) proximate to patient rooms

Objective 22: Eliminate preventable patient falls and resulting injuries

Principle 2: Achieve world-class quality and safety

Proposed Changes: There are several studies support the link between decentralization and more efficient use of nurse/staff time; however, they do not apply here. It is proposed to add a strategy on layout and efficient use of nurse/staff time.

Empirical Articles: 1

Expert Opinion Articles:

Background Discussion articles: 2

Peer reviewed articles: 1

Total References: 3

Research Summary: The only original research supporting a relationship between decentralization and reduced falls is Hendrich et al, 2004. However the study design has been criticized for failing to control for covariates. The two background discussion articles cite Hendrich et al. in their statement of a relationship between decentralization and reduced falls, but do not supply more support for this strategy.

Metric Status: 0

Metric Discussion: Distances from patient bed to key support spaces could be measured.

Researcher Initials: JZ

Reference Citations:

Hendrich, A.L., Fay, J., & Sorrells, A. K. (2004). Effects of acuity-adaptable rooms on the flow of patients and delivery of care. *American journal of critical care*, 13(1), 35-45.

Institute of Medicine. (2004). *Work and workspace design to prevent and mitigate errors*. In A. Page (Ed.), *Keeping patients safe: Transforming the work environment of nurses* (pp. 226-285). Washington, DC: National Academies Press.

Nelson, C, West, T., Goodman, C. (2005). *The Hospital Built Environment: What Role Might Funders of Health Services Research Play?* Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

Strategy 60: Decentralize staff support spaces (i.e., charting, supplies, medications) proximate to patient rooms

Objective 24: Optimize situational awareness of patients by staff throughout the care environment

Principle 2: Achieve world-class quality and safety

Proposed Changes: Include research on efficient use of nurse time and decentralized staff support spaces.

Empirical Articles:

Expert Opinion Articles:

Background Discussion articles:

Peer reviewed articles:

Total References: 0

Research Summary: No problems with the objective-strategy link. However there are no specific studies inquiring into the relationship between the two.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Strategy 72: Provide self-service kiosks

Objective 30: Maximize opportunities for patient/family participation in delivery of care & involvement in all care decisions

Principle 1: Provide patient and family-centered care

Proposed Changes:

Empirical Articles: 7

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 4

Total References: 10

Research Summary: Research focuses on patient characteristics that effect kiosk usage; prevalence of articles from UK

Metric Status: Various metrics found

Metric Discussion: Y/N metric; report targeted audience/patient area/use such as touch screen directories/way finding, registration, pharmacy, etc

Researcher Initials: AW

Reference Citations:

Fieler, V. K. & Borch, A. (1996) 'Results of a patient education project using a touch-screen computer', Cancer Practice, vol. 4, pp. 341 /345.

Gould, S. M. & Anderson, J. (2000) Using interactive multimedia nutrition education to reach low-income persons: an effective evaluation. Journal of Nutrition Education. 32(4): 204-213.

Hariri, S., Goodyer, L. I., Meyer, J. & Anderson, C. (2000). Assessment of a touch screen health promotion system in independent community pharmacies. Health Education Journal. 59(1): 99-107.

Jones, R. B., McGhee, S. M. & Hedley, A. J. (1991) 'The use of computers by the public and patients to obtain health information', in Proceedings of the First Hong Kong (Asia Pacific) Medical Informatics Conference 1990, eds A. J. Hedley & W.-C. Por, Hong Kong Society of Medical Informatics Limited and Hong Kong Computer Society, Hong Kong, pp. 91 /92.

Lewis, D. & , Nath, C. (1997). Feasibility of a Kiosk-Based Patient Education System in a Busy Outpatient Clinic Setting. The Diabetes Educator. 23(5):577-586.

Lindholm, I. H., Isacson, A., Slaug, B. & Moller, T. R. (1998) 'Acceptance by Swedish users of a multimedia program for primary and secondary prevention of malignant melanoma', Journal of Cancer Education, vol. 13, pp. 207 /212.

NCR (2009). U.S. Consumer Research reveals that patients want self-service to manage healthcare interactions. An NCR White Paper.

Nicholas, D., Huntington, P. & Williams, P. (2001) Health kiosk use: a national comparison study. Aslib Proceedings. 53(4): 130-140.

Pearson, J., Jones, R., Cawsey, A., McGregor, S., Barrett, A., Gilmour, H., Atkinson, J. & McEwan, J. (1999). The accessibility of information systems for patients: use of touch screen information systems by 345 patients with cancer in Scotland. Proceedings AMIA Symposium: 594-598.

Peters, J., & Jackson, M. (2005). Accessibility and Use of Touch screens by Black and Ethnic Minority Groups in the Three Cities Project. Ethnicity & Health, 10(3), 199-211.

Strategy 72: Provide self-service kiosks

Objective 4: Maximize patient/family satisfaction and well-being

Principle 1: Provide patient and family-centered care

Proposed Changes:

Empirical Articles: 1

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 1

Research Summary: One study cited indicates the use of kiosks in an adolescent facility contributed to high satisfaction

Metric Status: 0

Metric Discussion: Y/N metric; report targeted audience/patient area/user interface and function (e.g., directory, way finding, registration, pharmacy).

Researcher Initials: AW

Reference Citations:

Tivorsak, T. L., Britto, M. T., Klostermann, B. K., Nebrig, D. M., Slap, G. B. (2004). Are Pediatric Practice Settings Adolescent-Friendly? An Exploration of Attitudes and Preferences. Clinical Pediatrics. 43 (1): 55-61.z

Strategy 74: Provide a variety of comfortable and moveable furniture arranged in small, flexible groupings to accommodate the widest range of persons and families

Objective 4: Maximize patient/family satisfaction and well-being

Principle 1: Provide patient and family-centered care

Proposed Changes: The strategy should only apply only to family spaces where patient care activities do not occur (e.g., lounges, waiting rooms). In the patient room, it is a good idea to have a movable chair, but it is unsafe to have a variety of movable furniture items.

Empirical Articles: 4

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 4

Total References: 4

Research Summary: The Sommer article supports furniture arrangement as promoting between-resident social interaction in a residential care setting; Peterson saw results only for talking behavior for a similar population using similar environmental variables (moving furniture). Among psychogeriatric patients, Melin saw increases in talking and eating among the group with more socially-conducive furniture arrangements. Holohan saw similar increases in interactions among psychiatric patients in settings with "sociopetal" or mixed "sociopetal/sociofugal" seating arrangements.

Metric Status: 0

Metric Discussion: The strategy is fairly straightforward as written. It may be unnecessary to be very prescriptive about furniture arrangement.

Researcher Initials: JZ

Reference Citations:

Holahan, C. (1972). Seating patterns and patient behavior in an experimental dayroom. Journal of Abnormal Psychology, 80(2), 115-124.

Melin, L., & Gotestam, K. G. (1981). The effects of rearranging ward routines on communication and eating behaviors of psychogeriatric patients. Journal of Applied Behavior Analysis, 14(1), 47-51.

Peterson, R., Knapp, T., Rosen, J., & al., e. (1977). The effects of furniture arrangement on the behavior of geriatric patients. Behavior Therapy, 8, 464-467.

Sommer, R., & Ross, H. (1958). Social interaction on a geriatrics ward. The International Journal of Social Psychiatry, 4(2), 128-133.

Strategy 77: Provide clear spatial boundaries for waiting areas

Objective 4: Maximize patient/family satisfaction and well-being

Principle 2: Achieve world-class quality and safety

Proposed Changes: Study specifically describes as favorable when major lines of circulation are distant from waiting areas to avoid crowding and noise. The main problem is that a “spatial boundary”, such as a wall, line of columns or change in flooring material, may be insufficient to preempt crowding and noise.

Empirical Articles: 1

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 1

Research Summary: Researchers assessed three different waiting areas according to waiting and circulation patterns. Individuals prefer to have less crowded waiting spaces without major traffic patterns intruding on waiting spaces.

Metric Status: 0

Metric Discussion: More research needed to determine what constitutes a sufficient spatial boundary (e.g., a wall or physical distance).

Researcher Initials: MO

Research Citations:

Akalın-Baskaya & Yildirim. (2007). Design of circulation axes in densely used polyclinic waiting halls. Building and Environment, 42, 1743-1751.

Strategy 96: Provide adequate space for private work to minimize distractions and interruptions

Objective 36: Optimize workplace efficiency

Principle 4: Improve operational effectiveness

Proposed Changes: Change to or add OBJ 6: Eliminate medication errors

Empirical Articles: 0

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 2

Research Summary: No empirical research on this linkage; common sense

Metric Status: 0

Metric Discussion: No benchmarks on what qualifies as "adequate space" and in what patient areas.

Researcher Initials: AW

Reference Citations:

Institute of Medicine. 2007. Preventing Medication Errors: Quality Chasm Series. Washington D.C.: National Academies Press. Appendix D. p.413.

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Strategy 102: Maximize HEPA (99.97%) filtration for appropriate hospital areas

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: Due to lack of research showing effectiveness in the entire hospital, it is suggested to use two strategies: Use HEPA filtration in areas for immunocompromized patients, and Include negative/positive pressure rooms.

Empirical Articles: 11

Expert Opinion Articles: 3

Background Discussion articles: 1

Peer reviewed articles: 11

Total References: 15

Research Summary: Research supports that HEPA decreases HAI but references are for particular areas of the hospital. Most references show improved results for immunocompromised patients or surgical/transplant units. Research includes AIA and ASHRAE guidelines. References that do not support adoption relate to the importance of negative pressure rooms.

Metric Status: Various metrics found (no consensus)

Metric Discussion: Y/N metric; note which areas implemented; Use Schulster reference (CDC) for guidance.

Researcher Initials: AW

Reference Citations:

Abzug, M. J., Gardner, S., Glode, M. P., Cymanski, M., Roe, M. H., & Odom, L. F. (1992). Heliport-associated nosocomial mucormycoses. Infection Control and Hospital Epidemiology, 13(6), 325–326.

AIA & FGI (American Institute of Architects and Facilities Guidelines institute) (2006). Guidelines for design and construction of health care facilities. Washington, DC: American Institute of Architects.

Alberti, C., Bouakline, A., Ribaud, P., Lacroix, C., Rousselot, P., Leblanc, T., et al. (2001). Relationship between environmental fungal contamination and the incidence of invasive aspergillosis in hematology patients. Journal of Hospital Infection, 48(3), 198–206.

Arlet, G., Gluckman, E., Gerber, F., Perol, Y., & Hirsch, A. (1989). Measurement of bacterial and fungal air counts in two bone-marrow transplant units. Journal of Hospital Infection, 13(1), 63–69.

ASHRAE. 2004. ASHRAE 62.1-2004 – Ventilation for Acceptable Indoor Air Quality (ANSI Approved). Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

Boswell, T. C., & Fox, P. C. (2006). Reduction in MRSA environmental contamination with a portable HEPA-filtration unit. Journal of Hospital Infection, 63(1), 47–54.

Bouza, E., Pelaez, T., Perez-Molina, I., Marin, M., Alcala, L., Padilla, B., et al. (2002). Demolition of a hospital building by controlled explosion: The impact on filamentous fungal load in internal and external air. *Journal of Hospital Infection*, 52(4), 234–242.

Friberg, S., Ardnor, B., Lundholm, R., & Friberg, B. (2003). The addition of a mobile ultraclean exponential laminar airflow screen to conventional operating room ventilation reduces bacterial contamination to operating box levels. *Journal of Hospital Infection*, 55(2), 92–97.

Hahn, T., Cummings, M., Michalek, A. M., Lipman, B. J., Segal, B. H., & McCarthy, P. L. (2002). Efficacy of high-efficiency particulate air filtration in preventing aspergillosis in immunocompromised patients with hematologic malignancies. *Infection Control and Hospital Epidemiology*, 23(9), 525–531.

Noskin, G., & Peterson, L. (2001). Engineering Infection Control through Facility Design. *Emerging Infectious Diseases*, 7(2), 354

Oren, I., Haddad, N., Finkelstein, R., & Rowe, J. M. (2001). Invasive pulmonary aspergillosis in neutropenic patients during hospital construction: Before and after chemoprophylaxis and institution of HEPA filters. *American Journal of Hematology*, 66(4), 257–262.

Passweg, J. R., Rowlings, P. A., Atkinson, K. A., Barrett, A. J., Gale, R. P., Gratwohl, A., et al. (1998). Influence of protective isolation on outcome of allogeneic bone marrow transplantation for leukemia. [Article]. *Bone Marrow Transplantation*, 21(12)

Schulster, L., & Chinn, R. Y. (2003). Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *Morbidity and Mortality Weekly Report Recommendation Report*, 52(RR-10), 1–42.

Sherertz, R. J., Belani, A., Kramer, B. S., Elfenbein, G. J., Weiner, R. S., Sullivan, M. L., et al. (1987). Impact of air filtration on nosocomial *Aspergillus* infections: Unique risk of bone marrow transplant recipients. *American Journal of Medicine*, 83(4), 709–718.

Yavuz, S. S., Bicer, Y., Yapici, N., Kalaca, S., Aydin, O. O., Camur, G., et al. (2006). Analysis of risk factors for sternal surgical site infection: Emphasizing the appropriate ventilation of operating theaters. *Infection Control and Hospital Epidemiology*, 27(9), 958–963.

Strategy 106: Install windows that open

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: "Consider natural and/or displaced ventilation in climates where this is viable".

Empirical Articles: 2

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 3

Research Summary: Only one empirical reference supports the link between natural ventilation and reduced HAI. There is an increasing number of articles recently about firms considering natural and/or displaced ventilation within and outside of healthcare, but none are empirical studies.

Metric Status: 0

Metric Discussion: Y/N metric; note which areas implemented

Researcher Initials: AW

Reference Citations:

(2006). Displaced Ventilation in Hospitals? Consulting-Specifying Engineer, 40(6), 9-11. Retrieved from Academic Search Complete database.

Escombe AR, Oeser CC, Gilman RH, Navincopa M, Ticona E, et al. (2007) Natural ventilation for the prevention of airborne contagion. PLoS Med 4(2): e68. doi:10.1371/journal.pmed.0040068

Gulick, R. (2007). DISPLACEMENT VENTILATION IN HOSPITALS. Engineered Systems, 24(7), 48-54. Retrieved from Academic Search Complete database.

Strategy 106: Install windows that open

Objective 39: Reduce environment impact of materials

Principle 5: Be sustainable with a high level of community responsibility

Proposed Changes: "Consider natural and/or displaced ventilation in viable climates

Empirical Articles: 1

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 2

Research Summary: Increasing number of articles recently about firms considering natural and/or displaced ventilation within and outside of healthcare but none are empirical studies.

Metric Status: 0

Metric Discussion: Y/N metric; note which areas implemented

Researcher Initials: AW

Reference Citations:

(2006). Displaced Ventilation in Hospitals? Consulting-Specifying Engineer, 40(6), 9-11. Retrieved from Academic Search Complete database.

Emmerich, S. (2006). Simulated Performance of Natural and Hybrid Ventilation Systems in an Office Building. HVAC&R Research, 12(4), 975-1004.

Strategy 112: Strive for a comfortable and welcoming, non-institutional, visual aesthetic

Objective 4: Maximize patient/family satisfaction and well-being

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 1

Expert Opinion Articles: 1

Background Discussion articles: 1

Peer reviewed articles: 1

Total References: 3

Research Summary: Carpman makes the case for home-likeness; however, I don't have access to the book and its detailed methodology. Miwa found that clients at a counseling center space using dim lighting reported more self-disclosure, more pleasant feelings, and more positive evaluations of the counselor than clients in a brighter setting. Nelson cites evidence that more pleasant designs lead to happier employees and less staff turnover.

Metric Status: 0

Metric Discussion: Metrics unlikely as there are too many things to measure (e.g., color, furnishing, material, lighting). Further, a non-institutional look may be a trend, with patients of the future preferring a more institutional look.

Researcher Initials: JZ

Reference Citations:

Carpman, J. R., & Grant, M. A. (1993). Design that cares: Planning health facilities for patients and visitors (2nd ed.). Chicago: American Hospital Publishing, Inc.

Miwa, Y., & Hanyu, K. (2006). The Effects of Interior Design on Communication and Impressions of a Counselor in a Counseling Room. Environment and Behavior, 38(4), 484-502.

Nelson, C, West, T., Goodman, C. (2005). The Hospital Built Environment: What Role Might Funders of Health Services Research Play? Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

Strategy 122: Use low-impact, low-resonance floor materials where appropriate.

Objective 19: Optimize the acoustical environment

Principle 2: Achieve world-class quality and safety

Proposed Changes: If the concern is noise, ceiling materials should be addressed in the strategy as well.

Empirical Articles: 3

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 3

Total References: 4

Research Summary: Noise perception and some noise measurements decreased with carpeting.

Metric Status: Benchmark in place

Metric Discussion: The noise-reducing benefits of carpet must be balanced with potential infection risk, which is not clear without a new review of literature.

Researcher Initials: MO

Reference Citations:

Harris, D. (2000). Environmental Quality and Healing Environments: A Study of Flooring Materials in a Healthcare Telemetry Unit. Doctoral Dissertation. Texas A&M University, College Station, TX.

Joseph, A., Keller, A., and Gulwadi, G. (2009). Improving the Patient Experience: Best Practices for Safety-Net Clinic Redesign. The Center for Health Design report for California Healthcare Foundation.

Philbin, M. K., & Gray, L. (2002). Changing levels of quiet in an intensive care nursery. Journal of Perinatology: Official Journal of the California Perinatal Association., 22(6), 455-460.

Wilmott, M. (1986). The effect of a vinyl floor surface and carpeted floor surface upon walking in elderly hospital inpatients. Age and Aging, 15, 119-120.

Strategy 122: Use low-impact, low-resonance floor materials where appropriate

Objective 32: Eliminate staff injuries

Principle 3: Create a positive work environment

Proposed Changes:

Empirical Articles: 1

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 1

Total References: 2

Research Summary: Generally, softer floors result in reduced discomfort as compared with a hard floor, particularly for the lower extremities and the lower back. Objective measures have been less conclusive, with no consensus about the influence of flooring on any physiological or biomechanical measures. Investigations of the influence of flooring characteristics on discomfort suggest that elasticity, stiffness, and thickness play roles. Further research is needed on underlying physiological causes of standing discomfort and fatigue as well as the influence of flooring properties on subjective and objective measures.

Metric Status: No metrics found

Metric Discussion: None

Researcher Initials: YL

Reference Citations:

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Redfern, M and Cham, R. (2000). The Influence of Flooring on Standing Comfort and Fatigue. American Industrial Hygiene Association Journal, 61:700-708.

Strategy 125: Reduce or eliminate sources of noise; other patients, public address systems, equipment 'clatter', loud conversations at nurse stations

Objective 19: Optimize the acoustical environment

Principle 2: Achieve world-class quality and safety

Proposed Changes: If they are not present elsewhere in the checklist, add substrategies to address each noise source to be reduced/eliminated and how it may be achieved (noiseless paging systems, layouts that isolate loud functions, equipment spec, workplace policies to reduce noise.)

Empirical Articles: 2

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 2

Total References: 3

Research Summary: Paging, equipment, other patients, and staff conversation are main noise sources, often disrupting sleep. In two studies, Hagerman identified correlations between noise level and unfavorable physiological symptoms and medical outcomes (re-admission rates) among patients in louder environments. Workplace policy interventions are likely needed in addition to physical environment interventions to reduce noise levels. Nurse conversations and care activities are frequently implicated as noisy and sleep-disrupting.

Metric Status: Benchmark in place

Metric Discussion: benchmarks exist for noise levels

Researcher Initials: JZ

Reference Citations:

Gabor, J. Y., Cooper, A. B., Crombach, S. A., Lee, B., Kadikar, N., Bettger, H. E., et al. (2003). Contribution of the intensive care unit environment to sleep disruption in mechanically ventilated patients and healthy subjects. [Article]. American Journal of Respiratory and Critical Care Medicine Vol 167. pp. 708-715

Shepley, M. M., & Davies, K. (2003). Nursing Unit Configuration and Its Relationship to Noise and Nurse Walking Behavior: An AIDS/HIV Unit Case Study. AIA Academy Journal Retrieved 5/26/2004, 2004

Southwell, M. T., & Wistow, G. (1995). Sleep in Hospitals at Night - Are Patients Needs Being Met? [Article]. Journal of Advanced Nursing, 21(6), 1101-1109.

Strategy 131: Provide full height walls with high acoustic ratings in spaces where patients will be asked to disclose confidential information

Objective 3: Provide appropriate levels of patient privacy

Principle 1: Provide patient and family-centered care

Proposed Changes: Provide 'private rooms' enclosed with full height walls with high acoustic ratings in spaces where patients would be asked to disclose confidential information

(Since a study found that more breaches of patient confidentiality and privacy occurred in the multi-bed spaces with curtain partitions (Mlinek and Pierce 1997), we need to specify that we need to provide 'private rooms'.)

Empirical Articles: 3

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 3

Total References: 4

Research Summary: Patients in walled cubicles experienced fewer privacy incidents than those in curtained cubicles ($P < 0.05$). More breaches of patient confidentiality and privacy occurred in the multi-bed spaces with curtain partitions (Mlinek and Pierce 1997). Another measure for increasing patient confidentiality is providing private rooms enclosed with walls that go up to the ceiling, thereby preventing voice travel through ceilings in spaces where private patient information is likely to be shared. This review includes two studies above. (Mlinek and Pierce 1997; Barlas et al. 2001).

Metric Status: Benchmark in place

Metric Discussion: A survey with 11 questions (a 5-point Likert scale) regarding privacy has been used in the study (Barlas, D., Sama, A. E., Ward, M. F., & Lesser, M. L., 2001). A nine-item questionnaire using a Likert scale was used (Karro J, Dent AW, Farish S., 2005)

Researcher Initials: YS

Reference Citations:

Barlas, D., Sama, A. E., Ward, M. F., & Lesser, M. L. (2001). Comparison of the auditory and visual privacy of emergency department treatment areas with curtains versus those with solid walls. [Article]. Annals of Emergency Medicine, 38(2), 135-139.

Joseph, A., & Ulrich, R. (2007). Sound control for improved outcomes in healthcare settings. The Center for Health Design. Issue Paper #4

Karro, J., Dent, A. W., & Farish, S. (2005). Patient perceptions of privacy infringements in an emergency department. Emergency Medicine Australasia: EMA, 17(2), 117-123.

Mlinek, E. J., & Pierce, J. (1997). Confidentiality and privacy breaches in a university hospital emergency department. [Article]. Academic Emergency Medicine, 4(12), 1142-1146.

Strategy 135: Use high performance sound-absorbing ceiling tiles

Objective 19: Optimize the acoustical environment

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 1

Expert Opinion Articles: 1

Background Discussion articles: 1

Peer reviewed articles: 0

Total References: 3

Research Summary: No empirical studies published in a peer-reviewed journals were identified.

Metric Status: Various metrics found (no consensus)

Metric Discussion: Noise levels and LOS were identified as two variables.

Researcher Initials: AK

Reference Citations:

Altimier, L. B., Eichel, M., Warner, B., Tedeschi, L., & Brown, B. (2005). Developmental care: changing the NICU physically and behaviorally to promote patient outcomes and contain costs. Neonatal Intensive Care, 18(4), 12-16.

Joseph, A., & Ulrich, R. (2007). Sound control for improved outcomes in healthcare settings. The Center for Health Design. Issue Paper #4

Malkin, J. (2006). Designing a Better Environment. In S. Marberry (Ed.), Improving Healthcare with Better Building Design. Chicago: Health Administration Press, 113-114.

Strategy 135: Use high performance sound-absorbing ceiling tiles

Objective 3: Provide appropriate levels of patient privacy

Principle 1: Provide patient and family-centered care

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 1

Peer reviewed articles: 0

Total References: 2

Research Summary: No empirical studies published in a peer-reviewed journals were identified.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Joseph, A., & Ulrich, R. (2007). Sound control for improved outcomes in healthcare settings. The Center for Health Design. Issue Paper #4

Malkin, J. (2006). Designing a Better Environment. In S. Marberry (Ed.), Improving Healthcare with Better Building Design. Chicago: Health Administration Press, 113-114.

Strategy 160: Provide secure access to nature (i.e., central green zones)

Objective 11: Maximize Connections to Nature

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 3

Expert Opinion Articles: 6

Background Discussion articles: 0

Peer reviewed articles: 3

Total References: 9

Research Summary: Strong evidence exists for the effect of nature. It can reduce patient ratings of pain control and anxiety.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YL

Reference Citations:

Diette, G. B., Lechtzin, N., Haponik, E., Devrotes, A. and Rubin, H.R. (2003). Distraction therapy with nature sights and sounds reduces pain during flexible bronchoscopy: A complementary approach to routine analgesia. Chest 123(3): 941-948.

Marcus, C. C. & Barnes M. (Eds.) (1999). Healing Gardens: Therapeutic Benefits and Design Recommendations. New York: Wiley.

Marcus, C. C. & Barnes, M. (1995). Gardens in Healthcare Facilities: Uses, Therapeutic Benefits, and Design Recommendations. Concord, CA: The Center for Health Design.

Nelson, C. West, T., Goodman, C. (2005). The Hospital Built Environment: What Role Might Funders of Health Services Research Play? Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

Sherman, S. A., Varni, J. W., Ulrich, R. S., & Malcarne, V. L. (2005). Post-occupancy evaluation of healing gardens in a pediatric cancer center. Landscape and Urban Planning, 73(2-3), 167-183.

Ulrich, R. S. (1999). Effects of gardens on health outcomes: Theory and research. In C. Cooper Marcus & M. Barnes (Eds.), Healing Gardens. New York: Wiley, 27-86.

Ulrich, R. S. (2008, in press). Biophilic theory and research for health design. In S. Kellert, J. Heerwagen, and M. Mador (Eds.), Biophilic Design: Theory, Science and Practice. New York: John Wiley.

Ulrich, R., Zimring, C., Quan, W., and Joseph, A. (2004). The Role of the Physical Environment in the Hospital of the 21st Century: A Once-In-A-Lifetime Opportunity. The Center for Health Design.

Whitehouse, S., Varni, J. W., Seid, M., Cooper-Marcus, C., Ensberg, M. J., & Jacobs, J. R. (2001). Evaluating a children's hospital garden environment: Utilization and consumer satisfaction. *Journal of Environmental Psychology*, 21(3), 301-314.

Strategy 162: Provide outboard and midboard bathrooms to allow for more visual access to patient rooms from hallways

Objective 24: Optimize situational awareness of patients by staff throughout the care environment

Principle 2: Achieve world-class quality and safety

Proposed Changes: no evidence but follows commonsense

Provide outboard and midboard bathrooms to allow for more visual access to patient rooms from hallways

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 0

Research Summary: No evidence found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YS

Strategy 165: Provide visual connections to facilitate information seeking and interaction

Objective 32: Eliminate staff injuries

Principle 3: Create a positive work environment

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 0

Research Summary: No evidence found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YL

Strategy 168: Provide single patient rooms

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 7

Expert Opinion Articles: 3

Background Discussion articles: 6

Peer reviewed articles: 11

Total References: 14

Research Summary: Single patient rooms significantly decrease infections.

Metric Status: Benchmark in place

Metric Discussion: Presence of single patient room with separate door.

Researcher Initials: MO

Reference Citations:

AIA & FGI (American Institute of Architects and Facilities Guidelines institute) (2006). Guidelines for design and construction of health care facilities. Washington, DC: American Institute of Architects.

Ben-Abraham, R., Keller, N., Szold, O., Vardi, A., Weinberg, M., Barzilay, Z., et al. (2002). Do isolation rooms reduce the rate of nosocomial infections in the pediatric intensive care unit? [Article]. Journal of Critical Care, 17(3), 176-180.

Calkins, M., & Cassella, C. (2007). Exploring the cost and value of private versus shared bedrooms in nursing homes. The Gerontologist, 47(2), 169-183.

Farquharson, C., & Baguley, K. (2003). Responding to the severe acute respiratory syndrome (SARS) outbreak: lessons learned in a Toronto emergency department. Journal of emergency nursing, 20(3), 222-228.

Goldmann, D. A., Durbin, W. A., & Freeman, J. (1981). Nosocomial Infections in a Neonatal Intensive-Care Unit. [Article]. Journal of Infectious Diseases, 144(5), 449-459.

Harris, D. D., Shepley, M. M., White, R. D., Kolberg, K. J. S., & Harrell, J. W. (2006). The impact of single family room design on patients and caregivers: executive summary. [Article]. Journal of Perinatology, 26, S38-S48.

Joseph, A. (2006). The impact of the environment on infections in healthcare facilities. The Center for Health Design. Issue Paper #1.

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

McManus, A. T., Mason, A. D., McManus, W. F., & Pruitt, B. A. (1994). A Decade of Reduced Gram-Negative Infections and Mortality Associated with Improved Isolation of Burned Patients. [Article]. Archives of Surgery, 129(12), 1306-1309.

McManus, A. T., McManus, W. F., Mason, A. D., Aitchison, A. R., & Pruitt, B. A. (1985). Microbial Colonization in a New Intensive-Care Burn Unit - a Prospective Cohort Study. [Article]. Archives of Surgery, 120(2), 217-223.

Mulin, B., Rouget, C., Clement, C., Bailly, P., Julliot, M. C., Viel, J. F., Thouverez, M., Vieille, I., Barale, F., Talon, D. (1997). Association of private isolation rooms with ventilator-associated *Acinetobacter baumannii* pneumonia in a surgical intensive-care unit

Nelson, C, West, T., Goodman, C. (2005). The Hospital Built Environment: What Role Might Funders of Health Services Research Play? Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

Passweg, J. R., Rowlings, P. A., Atkinson, K. A., Barrett, A. J., Gale, R. P., Gratwohl, A., et al. (1998). Influence of protective isolation on outcome of allogeneic bone marrow transplantation for leukemia. [Article]. Bone Marrow Transplantation, 21(12)

Shirani, K. Z., McManus, A. T., Vaughan, G. M., McManus, W. F., Pruitt, B. A., & Mason, A. D. (1986). Effects of Environment on Infection in Burn Patients. [Article]. Archives of Surgery, 121(1), 31-36.

Strategy 168: Provide single patient rooms

Objective 21: Eliminate medication errors

Principle 2: Achieve world-class quality and safety

Proposed Changes: May be worthwhile to consider 'Provide enclosed medication room', which may provide a more direct connection between layout and reduced medication errors.

Empirical Articles: 0

Expert Opinion Articles: 2

Background Discussion articles: 1

Peer reviewed articles: 0

Total References: 2

Research Summary: Single patient rooms provide decreased noise and distraction, and provide more private workspace. All of these are thought to decrease error, but the single patient room itself has not been demonstrated to do so.

Metric Status: Benchmark in place

Metric Discussion: Presence of single patient room with separate door.

Researcher Initials: MO

Reference Citations:

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Ulrich, R. S., Zimring, C. M., Zhu, X., DuBose, J., Seo, H., Choi, Y., et al. (2008). A review of the research literature on evidence-based healthcare design. Health Environments Research & Design, 1(3), 61-125.

Strategy 168: Provide single patient rooms

Objective 22: Eliminate preventable patient falls and resulting injuries

Principle 2: Achieve world-class quality and safety

Proposed Changes: Reword objective to include preventing injuries and falling; No evidence for this strategy objective link. The references listed are around comprehensive patient fall programs that may include single patient rooms.

Empirical Articles: 2

Expert Opinion Articles: 1

Background Discussion articles: 1

Peer reviewed articles: 2

Total References: 4

Research Summary: No empirical evidence that states single patient rooms will reduce patient falls; most evidence is for acuity adaptable rooms

Metric Status: 0

Metric Discussion: None

Researcher Initials: AW

Reference Citations:

Brandis, S. (1999). A collaborative occupational therapy and nursing approach to falls prevention in hospital inpatients. Journal of Quality in Clinical Practice, 19(4), 215–221.

Chang, J. T., Morton, S. C., Rubenstein, L. Z., & Mojica, W. A. (2004). Interventions for the prevention of falls in older adults: Systematic review and meta-analysis of randomized clinical trials. British Medical Journal, 328(7441), 680.

Hendrich, A., Fay, J., & Sorrells, A. (2002). Courage to heal: Comprehensive cardiac critical care. Healthcare Design, 11–13.

Tan, K. M., Austin, B., Shaughnassy, M., Higgins, C., McDonald, M., Mulkerrin, E. C., et al. (2005). Falls in an acute hospital and their relationship to restraint use. Irish Journal of Medical Science, 174(3), 28–31.

Strategy 168: Provide single patient rooms

Objective 7: Maximize opportunities for social support

Principle 1: Provide patient and family-centered care

Proposed Changes: None

Empirical Articles: 2

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 2

Total References: 3

Research Summary: Research suggest increased family satisfaction and concomitant support, but single patient rooms decrease support that might otherwise have been available from other patients. However, the reduction in infection risk outweighs the social support. Single patient rooms should be suggested, but they may decrease social support.

Metric Status: Benchmark in place

Metric Discussion: Presence of single patient room with separate door.

Researcher Initials: MO

Reference Citations:

AIA & FGI (American Institute of Architects and Facilities Guidelines institute) (2006). Guidelines for design and construction of health care facilities. Washington, DC: American Institute of Architects.

Harris, D. D., Shepley, M. M., White, R. D., Kolberg, K. J. S., & Harrell, J. W. (2006). The impact of single family room design on patients and caregivers: executive summary. [Article]. Journal of Perinatology, 26, S38-S48.

Harris, P. B., McBride, G., Ross, C., & Curtis, L. (2002). A place to heal: Environmental sources of satisfaction among hospital patients. Journal of Applied Social Psychology, 32(6), 1276-1299.

Strategy 168: Provide single patient rooms

Objective 3: Provide appropriate levels of patient privacy

Principle 1: Provide patient and family-centered care

Proposed Changes: None

Empirical Articles: 3

Expert Opinion Articles: 1

Background Discussion articles: 3

Peer reviewed articles: 3

Total References: 6

Research Summary: Research suggest patients prefer privacy and it is more easily attainable in a single-patient room.

Metric Status: Benchmark in place

Metric Discussion: Presence of single patient room with separate door.

Researcher Initials: MO

Reference Citations:

Chaudhury, H., Mahmood, A., & Valente, M. (2006). Nurses' perception of single-occupancy versus multioccupancy rooms in acute care environments: An exploratory comparative assessment. Applied Nursing Research, 19, 118-125.

Harris, D. D., Shepley, M. M., White, R. D., Kolberg, K. J. S., & Harrell, J. W. (2006). The impact of single family room design on patients and caregivers: executive summary. [Article]. Journal of Perinatology, 26, S38-S48.

Harris, P. B., McBride, G., Ross, C., & Curtis, L. (2002). A place to heal: Environmental sources of satisfaction among hospital patients. Journal of Applied Social Psychology, 32(6), 1276-1299.

Joseph, A., & Ulrich, R. (2007). Sound control for improved outcomes in healthcare settings. The Center for Health Design. Issue Paper #4

Malkin, J. (2006). Designing a Better Environment. In S. Marberry (Ed.), Improving Healthcare with Better Building Design. Chicago: Health Administration Press, 113-114.

Nelson, C, West, T., Goodman, C. (2005). The Hospital Built Environment: What Role Might Funders of Health Services Research Play? Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

Strategy 168: Provide single patient rooms

Objective 4: Maximize patient/family satisfaction

Principle 1: Provide patient and family-centered care

Proposed Changes: None

Empirical Articles: 3

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 2

Total References: 3

Research Summary: Increased satisfaction in private room.

Metric Status: Benchmark in place

Metric Discussion: Presence of single patient room with separate door.

Researcher Initials: MO

Reference Citations:

Harris, D. D., Shepley, M. M., White, R. D., Kolberg, K. J. S., & Harrell, J. W. (2006). The impact of single family room design on patients and caregivers: executive summary. [Article]. Journal of Perinatology, 26, S38-S48.

Harris, P. B., McBride, G., Ross, C., & Curtis, L. (2002). A place to heal: Environmental sources of satisfaction among hospital patients. Journal of Applied Social Psychology, 32(6), 1276-1299.

Press Ganey, I. (2003). National satisfaction data for 2003 comparing patients with versus without a roommate: (Provided by Press Ganey, Inc. for this research report at the request of the authors.).

Strategy 169: Provide assistive devices (e.g., headwall rails, larger bathroom doors, bathroom location)

Objective 22: Eliminate preventable patient falls and resulting injuries

Principle 2: Achieve world-class quality and safety

Proposed Changes: Change to provide assistive devices and determine fall prevention operational plan

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 0

Research Summary: No supportive empirical research; Only articles that demonstrate ineffectiveness of bedrails

Metric Status: 0

Metric Discussion: Report on the assistive devices used and fall prevention operational plan

Researcher Initials: AW

Strategy 181: Provide flexible work spaces that accommodate a multitude of staff tasks and multidisciplinary use

Objective 36: Optimize staff efficiency and performance

Principle 4: Improve operational effectiveness

Proposed Changes: Decide to keep or not based on purpose of the checklist

Empirical Articles: 0

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 2

Research Summary: No empirical research on this linkage; common sense

Metric Status: 0

Metric Discussion: Define "flexible work spaces" in all patient areas

Researcher Initials: AW

Reference Citations:

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. The Center for Health Design. Issue Paper #3.

Joseph, A., Keller, A., and Gulwadi, G. (2009). Improving the Patient Experience: Best Practices for Safety-Net Clinic Redesign. The Center for Health Design report for California Healthcare Foundation.

Strategy 188: Careful selection of materials with clean-ability a key consideration

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 9

Expert Opinion Articles: 2

Background Discussion articles: 2

Peer reviewed articles: 13

Total References: 13

Research Summary: No problems with the objective-strategy link. The supporting evidence is strong

Metric Status: 0

Metric Discussion: There is no consensus in the literature on the appropriate area of focus. Majority of studies focus on survival of bacteria on given surfaces (floorings, faucets, etc...) within healthcare environments.

Researcher Initials: AK

Reference Citations:

Aygun, G., Demirkiran, O., Utku, T., Mete, B., Urkmez, S., Yilmaz, M., et al. (2002). Environmental contamination during a carbapenem-resistant *Acinetobacter baumannii* outbreak in an intensive care unit. [Article]. *Journal of Hospital Infection*, 52(4), 259-262.

Barker, J., Vipond, I. B., & Bloomfield, S. F. (2004). Effects of cleaning and disinfection in reducing the spread of Norovirus contamination via environmental surfaces. [Article]. *Journal of Hospital Infection*, 58(1), 42-49.

Beyer, D. J., & Belsito, D. V. (2000). Fungal contamination of outpatient examination rooms: is your office safe? *Dermatology nursing* 12(1), 51-53.

Blanc, D. S., Nahimana, I., Petignat, C., Wenger, A., Bille, J., & Francioli, P. (2004). Faucets as a reservoir of endemic *Pseudomonas aeruginosa* colonization/infections in intensive care units. [Article]. *Intensive Care Medicine*, 30(10), 1964-1968.

Boyce, J. M., Potter-Bynoe, G., Chenevert, C., & King, T. (1997). Environmental contamination due to methicillin-resistant *Staphylococcus aureus*: Possible infection control implications. [Article]. *Infection Control and Hospital Epidemiology*, 18(9), 622-6

Bures, S., Fishbain, J. T., Uyehara, C. F. T., Parker, J. M., & Berg, B. W. (2000). Computer keyboards and faucet handles as reservoirs of nosocomial pathogens in the intensive care unit. [Article]. *American Journal of Infection Control*, 28(6), 465-471.

Dettenkofer, M., Wenzler, S., Amthor, S., Antes, G., Motschall, E., & Daschner, F. D. (2004). Does disinfection of environmental surfaces influence nosocomial infection rates? A systematic review. [Review]. *American Journal of Infection Control*, 32(2), 84-89.

Griffiths, R., Fernandez, R., & Halcomb, E. (2002). Reservoirs of MRSA in the acute hospital setting: A systematic review. Contemporary Nurse: A Journal for the Australian Nursing Profession, 13(1), 38-49

Hota, B. (2004). Contamination, disinfection, and cross-colonization: Are hospital surfaces reservoirs for nosocomial infection? Clinical Infectious Diseases, 39(8), 1182-1189.

Lankford, M. G., Collins, S., Youngberg, L., Rooney, D. M., Warren, J. R., & Noskin, G. A. (2006). Assessment of materials commonly utilized in health care: Implications for bacterial survival and transmission. American Journal of Infection Control, 34(5)

Martinez, J. A., Ruthazer, R., Hansjosten, K., Barefoot, L., & Snyderman, D. R. (2003). Role of environmental contamination as a risk factor for acquisition of vancomycin-resistant enterococci in patients treated in a medical intensive care unit. Archives of Internal Medicine, 163(16), 1905-1912.

Noskin, G. A., Bednarz, P., Suriano, T., Reiner, S., & Peterson, L. R. (2000). Persistent contamination of fabric-covered furniture by vancomycin-resistant enterococci: Implications for upholstery selection in hospitals. [Article]. American Journal of Infection Control, 28(4), 311-313.

Wilson, A. P. R., Ridgway, G. L. (2006). Reducing hospital-acquired infection by design: the new University College London Hospital. Journal of Hospital Infection, 62, 264-269.

Strategy 190: Provide storage for surge preparedness (gurneys, haz-mat suits, etc.)

Objective 50: Ensure operational continuity and meet surge requirements

Principle 8: Design for maximum flexibility, standardization & growth

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 1

Research Summary: No empirical studies published in a peer-reviewed journals were identified.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Zilm, F. (2006). Planning for The Worst. Health Facilities Management, 19(3), 39-42.

Strategy 193: Have a surge plan in place (Receiving, Caring, Releasing, Information, etc.

Objective 50: Ensure operational continuity and meet surge requirements

Principle 8: Design for maximum flexibility, standardization and growth

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 6

Background Discussion articles: 4

Peer reviewed articles: 6

Total References: 6

Research Summary: Delineates assumptions and components of surge; ability to respond, physical environment as key components for any surge/disaster scenario. The physical plant should be addressed as component of surge planning.

Metric Status: 0

Metric Discussion: No agreed upon methodology. The problem here is inherent in the nature of disaster, and it is difficult to do any study.

Researcher Initials: MO

Reference Citations:

Barbisch, D. & Koenig, K. (2006). Understanding Surge Capacity: Essential Elements. Academic Emergency Medicine, 13 (11), 1098-1102.

France, D & levin, S. (2006). System complexity as a measure of safe capacity for the emergency department. Academic Emergency Medicine, 13 (11), 1212-1219.

Kelen, G., McCarthy, M. The Science of Surge. (2006). Academic Emergency Medicine, 13 (11), 1089-1094.

McCarthy, M, Aronsky, D. & Kelen, G. (2006). The measurement of daily surge and its relevance to disaster preparedness. Academic Emergency Medicine, 13 (11), 1138-1141.

Zilm, F. (2006). Planning for the Worst. Health Facilities Management, 19(3), 39-42.

Zilm, F., & Lennon, J. (2003). ED Innovations: New challenges require new ideas. Health Facilities Management, 16(6), 43-46.

Strategy 194: Provide designated surge areas for waiting, screening, exam and treatment

Objective 50: Ensure operational continuity and meet surge requirements

Principle 8: Design for maximum flexibility, standardization & growth

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 2

Total References: 2

Research Summary: No empirical studies found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Zilm, F. (2006). Planning for the Worst. Health Facilities Management, 19(3), 39-42.

Zilm, F. (2007). A New Era of Emergency Care: Planning and Design Consideration. The Journal of Ambulatory Care, 30(3), 259-263.

Strategy 195: Design to accommodate gurney movement, staging, and cleaning during surge

Objective 50: Ensure operational continuity and meet surge requirements

Principle 8: Design for maximum flexibility, standardization & growth

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 1

Research Summary: No empirical studies found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Zilm, F. (2007). A New Era of Emergency Care: Planning and Design Consideration. The Journal of Ambulatory Care, 30(3), 259-263.

Strategy 198: Provide large scale decontamination capabilities

Objective 50: Ensure operational continuity and meet surge requirements

Principle 8: Design for maximum flexibility, standardization & growth

Proposed Changes: Either in the strategy or in some supporting text or endnotes, we might mention ways to do this. Zilm (2003) recommends putting decontamination near ambulance ingress and keeping it in regular use (e.g., cleaning EMS boards). Zilm (2006) notes the need to include decontamination areas as part of staff flows in planning and design. Elsewhere the recommendation exists that parking decks be made convertible to large-scale decontamination spaces.

Empirical Articles: 0

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 2

Research Summary: see "proposed changes"

Metric Status: 0

Metric Discussion: None

Researcher Initials: JZ

Zilm, F. (2006). Planning for the Worst. Health Facilities Management, 19(3), 39-42.

Zilm, F., & Lennon, J. (2003). ED Innovations: New challenges require new ideas. Health Facilities Management, 16(6), 43-46.

Strategy 206: Provide multiple spiritual spaces and haven areas for patient/family/staff

Objective 4: Maximize patient/family satisfaction and well-being

Principle 2: Achieve world-class quality and safety

Proposed Changes: List possible types, dimensions, and programmatic functions of spaces. See "research summary/narrative" for examples from bereavement.

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 0

Total References: 1

Research Summary: The following recommendations are made to support bereavement: (quoted from InformeDesign, www.informedesign.umn.edu. REWORD if these will be fed forward into checklist text) "Allow for the integration of religious, spiritual, or other cultural beliefs and practices in acute care settings to assist in grieving and bereavement. Provide a private, quiet, furnished room for grieving family members to gather immediately following loss. Provide a space for surviving friends and family members to view the body of the deceased in the acute care setting. Include space for initial counseling sessions for surviving friends and family members in an acute care center."

Metric Status: 0

Metric Discussion: None

Researcher Initials: JZ

Reference Citations:

Fauri, D. P., Ettner, B. & Kovacs, P. J. (2000). Bereavement services in acute care settings. *Death Studies*, 24 (1), 51-64.

Strategy 206: Provide multiple spiritual spaces and haven areas for patient/family/staff

Objective 7: Maximize opportunities for social support

Principle 1: Provide patient and family-centered care

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 0

Research Summary: No evidence found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YL

Strategy 210: Avoid harmful chemicals in building materials and supplies.

Objective 38: Optimize indoor environmental quality

Principle 2: Achieve world-class quality and safety

Proposed Changes: No studies exploring the link between the two were found.

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 0

Research Summary: No evidence found

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Strategy 213: Avoid use of furniture and furnishings that contain harmful chemicals (i.e., PBDE, PFA, urea-formaldehyde, phthalate and plasticizers)

Objective 38: Optimize indoor environmental quality

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 0

Research Summary:

Research support comes from two sources:

<http://www.epa.gov/iaq/formalde.html> <http://copublications.greenfacts.org/en/indoor-air-pollution/index.htm>

[http://www.portableachelp.com/Improving Indoor Air Quality.asp](http://www.portableachelp.com/Improving%20Indoor%20Air%20Quality.asp)

Metric Status: 0

Metric Discussion: None

Researcher Initials: YS

Strategy 218: Use proper water treatment

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: The strategy is too broad. It is suggested to eliminate this strategy and only have Strategy Number 270 with the changes described below.

Empirical Articles: 1

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 2

Research Summary: The strategy should be amended based on a closer review and summary of all evidence. Each specific recommendation made by the checklist should be supported by evidence from the sources below.

Metric Status: Benchmark in place

Metric Discussion: Delete this strategy.

Researcher Initials: MO

Reference Citations:

AIA & FGI (American Institute of Architects and Facilities Guidelines institute) (2006). Guidelines for design and construction of health care facilities. Washington, DC: American Institute of Architects.

Sehulster, L. M., Chinn, R. Y. W., Arduino, M. J., Carpenter, J., Donlan, R., Ashford, D., et al. (2004). Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Adv

Strategy 229: Protect occupied spaces by using effective control measures during construction

Objective 39: Reduce environment impact of materials

Principle 5: Be sustainable with a high level of community responsibility

Proposed Changes: None

Empirical Articles: 6

Expert Opinion Articles: 2

Background Discussion articles: 0

Peer reviewed articles: 6

Total References: 8

Research Summary: There is strong evidence of the positive impact of using HEPA filters for air intakes near construction and renovation sites (Loo, et al., 1996; Mahieu, De Dooy, Van Laer, Jansens, & Leven, 2000; Opal, et al., 1986; Oren, et al., 2001). A study by Humphreys et al. (1991) demonstrates that HEPA filters are not by themselves an adequate control measure and must be employed in conjunction with other measures such as enhanced cleaning, the sealing of windows, and barriers. Cornet et al. (1999) concludes that carefully directed airflow (e.g., laminar airflow) is important. However, in their extensive literature review, Ulrich and colleagues (2004) were unable to find and document cost-benefit analysis in the literature to justify the expense versus effectiveness of laminar airflow for patient-care areas near construction and renovation sites.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YL

Reference Citations:

Humphreys, H., Johnson, E. M., Warnock, D. W., Willatts, S. M., Winter, R. J., & Speller, D. C. E. (1991). An Outbreak of Aspergillosis in a General ITU. [Article]. Journal of Hospital Infection, 18(3), 167-177.

Iwen, P. C., Davis, J. C., Reed, E. C., Winfield, B. A., & Hinrichs, S. H. (1994). Airborne Fungal Spore Monitoring in a Protective Environment During Hospital Construction, and Correlation with an Outbreak of Invasive Aspergillosis. [Article]. Infection

Joseph, A. (2006). The impact of the environment on infections in healthcare facilities. The Center for Health Design. Issue Paper #1.

Loo, V. G., Bertrand, C., Dixon, C., Vitye, D., DeSalis, B., McLean, A. P. H., et al. (1996). Control of construction-associated nosocomial aspergillosis in an antiquated hematology unit. [Article]. Infection Control and Hospital Epidemiology, 17(6), 360-

McDonald, L. C., Walker, M., Carson, L., Arduino, M., Aguerro, S. M., Gomez, P., et al. (1998). Outbreak of Acinetobacter spp. bloodstream infections in a nursery associated with contaminated aerosols and air conditioners. [Article]. Pediatric Infectious D

Opal, S. M., Asp, A. A., Cannady, P. B., Morse, P. L., Burton, L. J., & Hammer, P. G. (1986). Efficacy of Infection Control Measures During a Nosocomial Outbreak of Disseminated Aspergillosis Associated with Hospital Construction. [Note]. Journal of Infection

Oren, I., Haddad, N., Finkelstein, R., & Rowe, J. M. (2001). Invasive pulmonary aspergillosis in neutropenic patients during hospital construction: Before and after chemoprophylaxis and institution of HEPA filters. [Article]. American Journal of Hematology

Sehulster, L. M., Chinn, R. Y. W., Arduino, M. J., Carpenter, J., Donlan, R., Ashford, D., et al. (2004). Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Adv

Strategy 239: Design to accommodate future expansion

Objective 52: Optimize space utilization and flexibility over time

Principle 8: Design for maximum flexibility, standardization & growth

Proposed Changes: New Strategy and new objective proposed (was a stand-alone strategy- str#239)

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 1

Research Summary: No empirical studies found.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Eagle, A. (2006). The future is now. Flexibility and expandability drive hospital project. Health Facilities management 19 (4), p.14-20.

Strategy 246: Support hand washing with conveniently placed sinks, hand washing liquid dispensers and alcohol rubs

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: Consider HAI-related objectives for three sources: waterborne, airborne and contact infections.

Empirical Articles: 17

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 17

Total References: 18

Research Summary: Although there are multiple cases of counter-evidence, the objective-strategy link remains strong in the literature.

Metric Status: Benchmark in place

Metric Discussion: The bed to sink ratio is adopted across studies.

Researcher Initials: AK

Reference Citations:

Bischoff, W. E., Reynolds, T. M., Sessler, C. N., Edmond, M. B., & Wenzel, R. P. (2000). Hand washing compliance by health care workers - The impact of introducing an accessible, alcohol-based hand antiseptic. [Article]. Archives of Internal Medicine, 160(7):1017-21.

Boyce, J. M., & Pittet, D. (2002). Guideline for hand hygiene in health-care settings - Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. 1-45.

Cohen, B., Saiman, L., Cimiotti, J., & Larson, L. (2003). Factors associated with hand hygiene practices in two neonatal intensive care units. Pediatric Infectious Disease Journal, 22(6), 494-498.

Creedon, S. A. (2005). Healthcare workers' hand decontamination practices: compliance with recommended guidelines. [Article]. Journal of Advanced Nursing, 51(3), 208-216.

Girou, E., Loyeau, S., Legrand, P., Oppein, F., & Brun-Buisson, C. (2002). Efficacy of hand rubbing with alcohol based solution versus standard hand washing with antiseptic soap: randomized clinical trial. British Medical Journal, 325(7360), 362-365.

Gordin, F. M., Schultz, M. E., Huber, R. A., & Gill, J. A. (2005). Reduction in nosocomial transmission of drug-resistant bacteria after introduction of an alcohol-based hand rub. Infection Control and Hospital Epidemiology, 26(7), 650-653.

Graham, M. (1990). Frequency and duration of hand washing in an intensive-care unit. American Journal of Infection Control, 18(2), 77-80.

Hugonnet, S., Perneger, T. V., & Pittet, D. (2002). Alcohol-based hand rub improves compliance with hand hygiene in intensive care units. Archives of Internal Medicine, 162(9), 1037-1043.

Johnson, P. D. R., Martin, R., Burrell, L. J., Grabsch, E. A., Kirska, S. W., O'Keeffe, J., et al. (2005). Efficacy of an alcohol/chlorhexidine hand hygiene program in a hospital with high rates of nosocomial methicillin-resistant Staphylococcus aureus (MRSA) infection, 183(10):509-14.

Kaplan, L. M., & McGuckin, M. (1986). Increasing hand washing compliance with more accessible sinks. Infection Control and Hospital Epidemiology, 7(8), 408-410.

Karabay, O., Sencan, I., Sahin, I., Alpteker, H., Ozcan, A., & Oksuz, S. (2005). Compliance and efficacy of hand rubbing during in-hospital practice. Medical Principles and Practice, 14(5), 313-317.

Lam, B. C. C., Lee, J., & Lau, Y. L. (2004). Hand hygiene practices in a neonatal intensive care unit: A multimodal intervention and impact on nosocomial infection. Pediatrics, 114(5), E565-E571.

Larson, E. L., Albrecht, S., & O'Keefe, M. (2005). Hand hygiene behavior in a pediatric emergency department and a pediatric intensive care unit: Comparison of use of 2 dispenser systems. American Journal of Critical Care, 14(4), 304-310.

Larson, E. L., Bryan, J. L., Adler, L. M., & Blane, C. (1997). A multifaceted approach to changing hand washing behavior. American Journal of Infection Control, 25(1), 3-10.

Pittet, D., Hugonnet, S., Harbarth, S., Mourouga, P., Sauvan, V., Touveneau, S., et al. (2000). Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Lancet, 356(9238), 1307-1312.

Randle, J., Clarke, M., & Storr, J. (2006). Hand hygiene compliance in healthcare workers. Journal of Hospital Infection, 64(3), 205-209.

Trick, W. E., Michael O. Vernon, Sharon F. Welbel, Patricia DeMarais, Mary K. Hayden and Robert A. Weinstein. (2007). Multicenter intervention program to increase adherence to hand hygiene recommendations and glove use and to reduce the incidence of antimicrobial resistance. Infection control and hospital epidemiology, 28(1):42-9.

Tvedt, C., & Bukholm, G. (2005). Alcohol-based hand disinfection: a more robust hand-hygiene method in an intensive care unit. Journal of Hospital Infection, 59(3), 229-234.

Strategy 256: Standardize treatment and exam room designs

Objective 50: Ensure operational continuity and meet surge requirements

Principle 8: Design for maximum flexibility, standardization & growth

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 0

Total References: 1

Research Summary: No empirical studies identified in literature.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Zilm, F., & Lennon, J. (2003). ED Innovations: New challenges require new ideas. Health Facilities Management, 16(6), 43-46.

Strategy 270: Fountain water temperature should be kept cold and fountains should be regularly cleaned and maintained

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: Change strategy to recommend specific cleaning schedule and temperature as cited in literature.

Empirical Articles: 0

Expert Opinion Articles: 0

Background Discussion articles: 1

Peer reviewed articles: 1

Total References: 1

Research Summary: Review/summary of all evidence- each recommendation cited by evidence, specific recommendations made. Change Strategy. Word for word recommendation in this report- evidence cited Level IB. Waiting for access to original article.

Metric Status: Benchmark in place

Metric Discussion: Change strategy to recommend specific cleaning schedule and temperature as cited in literature.

Researcher Initials: MO

Reference Citations:

Sehulster, L. M., Chinn, R. Y. W., Arduino, M. J., Carpenter, J., Donlan, R., Ashford, D., et al. (2004). Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Adv

Strategy 272: Avoid decorative water fountains in high-risk patient areas

Objective 20: Eliminate healthcare-acquired infections

Principle 2: Achieve world-class quality and safety

Proposed Changes: None

Empirical Articles: 0

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 1

Total References: 1

Research Summary: No evidence found.

Metric Status: Benchmark in place

Metric Discussion: High-risk unclear- again, waiting for original article.

Researcher Initials: MO

Reference Citations:

Sehulster, L. M., Chinn, R. Y. W., Arduino, M. J., Carpenter, J., Donlan, R., Ashford, D., et al. (2004). Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Adv

Strategy 274: Ergonomically evaluate work areas

Objective 32: Eliminate staff injuries

Principle 3: Create a positive work environment

Proposed Changes: None

Empirical Articles: 2

Expert Opinion Articles: 1

Background Discussion articles: 0

Peer reviewed articles: 2

Total References: 3

Research Summary: Ergonomic evaluations of the work area of different types of nursing staff might provide solutions to problems that are specific to different groups. For example, based on an ergonomic evaluation of the work area of scrub nurses in the operating room, Gerbrands and colleagues (2004) provided short-term solutions for reducing the neck and back problems experienced by this group as well as suggested guidelines for operating-room design. Some suggestions included height-adjustable footstools, better monitor placement, and ergonomically designed instrument tables to help reduce neck and back torsion experienced by these nurses as they attempted to obtain an unobstructed view of the operating field and reached for instruments on instrument tables in the operating room.

Another study was conducted in two units of a nursing home to prove that ergonomic innovation can reduce back stress and injuries caused to nursing assistants by patient transfers and other physical chores (Grag 1992).

Another area where additional ergonomics research is needed is in the design of computer workstations for nurses, since, with increasing documentation requirements, nurses are likely to spend more time at these workstations.

Metric Status: 0

Metric Discussion: None

Researcher Initials: YL

Reference Citations:

Garg, A., & Owen, B. (1992). Reducing back stress to nursing personnel: an ergonomic intervention in a nursing home. *Ergonomics*, 35(11), 1353-1375.

Gerbrands, A., A. Albayrak, and G. Kazemier. 2004. Ergonomic evaluation of the work area of the scrub nurse. *Minimally Invasive Therapy and Allied Technology* 13(3): 142-146.

Joseph, A. (2006). The Role of the Physical and Social Environment in Promoting Health, Safety and Effectiveness in the Healthcare Workplace. *The Center for Health Design. Issue Paper #3.*

Strategy 2011: Provide a way finding plan

Objective 34: Provide clear and intuitive way finding

Principle 1: Create a positive work environment

Proposed Changes: None

Empirical Articles: 7

Expert Opinion Articles: 5

Background Discussion articles: 0

Peer reviewed articles: 6

Total References: 12

Research Summary: Emphasis is on the issues around confidently navigating in hospital environments. Research supports the value of graphic signage and architectural qualities (landmarks and spatial differentiation) in terms of way finding in healthcare environments.

Metric Status: 0

Metric Discussion: None

Researcher Initials: AK

Reference Citations:

Arthur, P., & Passini, R. (1992). Way finding: People, signs, and architecture. New York: McGraw-Hill Book Co.

Baskaya, A., Wilson, C., & Ozcan, Y. Z. (2004). Way finding in an unfamiliar environment - Different spatial settings of two polyclinics. Environment and Behavior, 36(6), 839-867.

Carpman, J. R., & Grant, M. A. (1993). Design that cares: Planning health facilities for patients and visitors (2nd ed.). Chicago: American Hospital Publishing, Inc.

Carpman, J. R., Grant, M. A., & Simmons, D. A. (1985). Hospital design and way finding: A video simulation study. Environment & Behavior, 17(3), 296-314.

Carpman, J. R., Grant, M., & Simmons, D. (1983). Way finding in the hospital environment: The impact of various floor numbering alternatives. Journal of Environmental Systems, 13(4), 353-364.

Carpman, J. R., Grant, M., & Simmons, D. (1984). No more mazes: Research about design for way finding in hospitals. Ann Arbor, Michigan: The University of Michigan Hospitals.

Drinkard, J. L. (1984). Way finding in the hospital environment: A design analysis. Unpublished thesis, Georgia Institute of Technology, Atlanta, GA.

Joseph, A., Keller, A., and Gulwadi, G. (2009). Improving the Patient Experience: Best Practices for Safety-Net Clinic Redesign. The Center for Health Design report for California Healthcare Foundation.

Nelson, C. West, T., Goodman, C. (2005). The Hospital Built Environment: What Role Might Funders of Health Services Research Play? Rockville, MD: Agency for Healthcare Research and Quality, Publication Number 05-0106-EF.

O'Neill, M. J. (1991). Effects of signage and floor plan configuration on way finding accuracy. Environment and Behavior, 23(5), 553-574.

Peponis, J., Zimring, C., & Choi, Y. K. (1990). Finding the building in way finding. Environment & Behavior, 22(5), 555-590.

Werner, S., & Schindler, L. E. (2004). The role of spatial reference frames in architecture - Misalignment impairs way-finding performance. Environment and Behavior, 36(4), 461-482.